with two of these names, leaving the first word for the definition of persons engaged more obviously in the extension of chemical knowledge or the application of chemical principles.

Pharmacy is an honourable occupation, and I cannot believe that the pharmacist would lose dignity or status by the change. Comparatively few pharmacists are chemists in the modern sense, and it is well known that in other great countries this confusion of titles does not prevail; in fact, this is one of the few points on which we are at variance with our Allies, whilst they are in complete harmony with the Hun.

M. O. FORSTER.

Savage Club, W.C.2, March 4.

Graphic Methods in Nautical Astronomy.

IN the issue of NATURE published on October 24 last (vol. cii., p. 155) there appeared an account of an ingenious chart devised by Mr. G. W. Littlehales, of the United States Hydrographic Department, for dealing rapidly with certain problems in nautical astronomy which involve the solution of a spherical triangle when the three sides, or the two sides and the included angle, are known. The article is entitled "A New Graphic Method in Nautical Astronomy," but it would appear that the idea has been familiar in France for more than five-and-twenty years. The possibility of constructing a chart like that made by Mr. G. W. Littlehales was demonstrated by Maurice d'Ocagne so long ago as 1891 in his work "Nomographie: les calculs usuels effectués au moyen des abaques," p. 84, and an abacus devised by him on these lines was described in W. Dyck's "Katalog mathematischer und mathematisch-physikalischer Modelle, Apparate und Instrumente," published in 1892, p. 163. A figure of the chart can be found in a paper by d'Ocagne which appeared in the *Journal de l'Ecole Polytechnique* (second series, 4th cahier, 1898, p. 224), and also in his "Traité de Nomographie," 1899, p. 328. In a modified form the chart was employed by E. Collignon in 1898 (see his "Note sur la détermination de l'heure du passage du soleil dans un plan vertical," *Journal de l'École Polytechnique, loc. cit.*, pp. 123–35).

As drawn by Mr. Littlehales the chart occupies a square of 15-in. side. From 5° to 175° it is graduated to single degrees, and over a large part of the scale can be read by estimation to 6′. Although the printing of two copies obtained from Mr. Potter, agent for Admiralty charts, Minories, London (price 2*s.* 6*d.* each), is roughly executed, the chart is capable of doing good service in providing a rapid means of checking the results of calculation. The particular cases in the solution of spherical triangles it is designed to deal with, frequently occur in the reduction of crystal measurements, and the use of the chart can be confidently recommended to crystallographers.

A. HUTCHINSON.

The Mineralogical Laboratory, Cambridge, February 26.

Curious Markings on Chalk.

IN NATURE of March 6 there appeared a short notice of a piece of chalk said to be carved to represent a mammoth. This specimen was described and figured by Mr. Reid Moir in the February issue of *Man*, p. 17, pl. B. Examination of the figures there given shows that the object is nothing more than a somewhat imperfect natural cast of a chamber of the shell of an Ammonite. It is significant that in some parts of the country where such casts are not uncommon the quarrymen call them "pigs."

CHAS. W. ANDREWS.

British Museum (Natural History), March 8.

Globular Clusters, Cepheid Variables, and Radiation.

(1) THE determination of the past duration of solar radiation, and, consequently, the problem of the age of the inhabitable earth, imposes upon theories of radiation a difficulty the magnitude and fundamental importance of which appear to be too infrequently considered. The difference in the time-scales derived from the gravitational theory of solar energy and from geological and astronomical observation is not one of a few per cent. (or less) of the basic quantities involved, as is generally the case with the discrepancies that have led to conspicuous modifications of radiation theories; the discrepancy is rather a matter of a hundred to one, or even of a thousand or more to one. A more glaring disagreement could scarcely be imagined between a generally accepted and thoroughly workable theory on one hand, and, on the other, a mass of observation now too extensive and varied to be denied and some equally formidable physical laws.

Until recently the arguments for a long time-scale have been mostly geological and biological, and they have not been strongly insisted upon; imperfections in the geological records have been held to minimise the disagreement with the Helmholtz-Kelvin contraction theory of the sun. Similarly, the arguments for the short time-scale have not been too convincing, to some geologists at least, because of the promising possibility of finding new sources of energy or other escape from the physical theory. Hence on both sides of the question there has been a feeling of uncertainty relative to the validity and finality of opposing arguments, and on neither side has the discrepancy been strongly emphasised as a critical point for theories of radiation and the structure of matter.

(2) In recent volumes of NATURE the limited possibilities of the gravitational contraction of the sun in the problem of the age of the earth have been argued anew by Lindemann,[1] Jeans,[2] and Eddington.[3] The energy of contraction, as is well known, is essentially self-regulating for gaseous stars, and its evaluation is a clear and straightforward process. The available supplementary sources of energy seem incompetent; the heat of chemical combinations, an assumed increase in the specific heat, any definitely recognised atomic supply—all such as these appear quite insufficient to affect the problem. In fact, Jeans has shown by a calculation, remarkable both for its brevity and directness, that the total capacity of all electrical sources of energy (including the chemical and radio-active) must be comparatively small. He concludes: "It accordingly looks as though the Helmholtz contraction will provide much more energy than any other source, and we must apparently adjust our views to the time-scale set by the contraction theory."

Eddington[4] has pointed out important objections to the rather bizarre conception of obtaining great stores of energy through the gradual annihilation of matter, positive and negative electrons occasionally annulling each other.

Hence, unless we question, in some manner wholly new, the strict application of the gravitational theory, we may feel now more certain than ever that the sun could have radiated at the present rate for only a few million years.

(3) The main purpose of this note is to remark that recent developments in stellar astronomy make it unnecessary to rely on geological evidence alone for the proof of a vastly longer duration of solar radiation than the gravitational hypothesis admits. Thus the argument need no longer involve only the indefinite opposing of the tenets and conclusions of one science

[1] Vol. xcv., pp. 203, 372 (1915). [2] Vol. xcix., p. 444 (1917).
[3] Vol. xcix., p. 445 (1017).
[4] *Loc. cit.* and Monthly Notices, vol. lxxvii., p. 611 (1917).